Gaia Science Operations Centre

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1. Introduction

The SOC hosts the data hub for the Gaia data processing (Sect. 4) and must carefully balance ESA style standards (and bureaucracy) with the scientific communities creativity and dedication. SOC is closely involved with the DPAC (Sect 2) and is the communities interface to the satellite through MOC. SOC takes a direct development role not just in the operations software such as POS (Sect. 3) but in some of the science processing software such as the Astrometric Global Iterative Solution (AGIS) Hobbs et al. (2008). SOC is a major contributor to the GaiaTools library (Sect. 5). During mission operations SOC will run both operations type software as well as science processing systems such as IDT (Sect 6) and AGIS. Some further details are given bellow.

2. Data Processing and Analysis Consortium (DPAC)

In May 2007 with approval from ESA's Science Programme Committee (SPC) DPAC was formalized as a pan-European consortium in charge of designing, implementing, and operating the data processing system needed to create the Gaia catalogue. DPAC adopted the ECSS (European Cooperation on Space Standardization) software engineering standards and practices tailored for the Gaia project while following a cyclic development model in which software modules are incrementally built. The time to launch is subdivided into phases of six months durations. A large emphasis is placed on unit/integration and end-to-end system testing.

3. Payload Operations System (POS)

The function of the POS is to support all payload operations activities performed at the Gaia Science Operations Centre (SOC). The POS shall support the following activities:
- Monitoring the execution of the Nominal Scanning Law
- Calculation of transition times between the Nominal and Modified Scanning Law
- Generation of the Science Schedule containing the predicted on-board data rate according to the Scanning Law, galaxy and instrument models
- Tracking the current status and history of configuration parameters of payload
- Creating and dispatching of Scientific Operations Requests, including the generation of updates to configuration parameters of payload systems
- Tracking the execution of Scientific Operations Requests through the Mission Timeline and Telecommand History
- Processing of optical observations of Gaia received from DPAC into the required format for the MOC (for improving Gaia position and velocity data from standard ranging measurements)

4. Gaia Main Database (MDB)

The MDB is the central repository for all the data produced by Gaia and the DPAC. The system shall be operated at ESAC but its development and definition involves all of the the CUs. The MDB is the hub for all Gaia processing in that it provides the input data for, and receives the generated output from, all processing systems. The details of these relations are specified in the MDB Interface Control Document (ICD). The MDB will hold a range of different data types and the total data volume that the MDB will ultimately contain is still somewhat uncertain but it shall be of the order of hundreds of Terabytes and could even reach the Petabyte range.

The MDB will contain a number of version-controlled results data bases that will form a sequence $V_0, V_1 \ldots V_n$. Each V_m comprises three main parts, viz. *raw data*, coming from the satellite, *intermediate data* generated by the pre-processing pipeline and *reduced data*, coming from the various processing systems. The reduced data in any V_m is only produced from data contained in the previous V_{m-1}. The versions will be produced cyclically at regular intervals, e.g. every 6 months.

5. GaiaTools library and Parameter DB

GaiaTools is a common software library collaboratively written in Java to support and facilitate the software development in DPAC. The principle reasons for GaiaTools are to avoid duplication of effort and reduce errors in common routines. Policy decisions are taken by a GaiaTools committee composed of one representative from each CU All code development is done by DPAC members in a distributed manner following DPAC's software engineering guidelines. Functionality in GaiaTools range from the Data Access Layer (DAL) and plotting through general numerical routines (Vector+Matrix algebra, interpolation etc) to Solar System ephemeris access.

The Gaia Parameter Database (GPDB) is a central, searchable repository of all mathematical, physical, mission, satellite, and payload design parameters with relevance for Gaia. A Java export of the GPDB is distributed together with the GaiaTools library.

6. Initial Data Treatment

IDT can be regarded as a pre-processing pipeline converting raw telemetry from the satellite into higher level data products for downstream software (like AGIS). It will be operated in a quasi-continuous manner at SOC to process telemetry in near-real time. Telemetry data will go into a *Raw Database* - processed data into a IDT/FL database and from there into the Main Data Base (Sect. 4. The primary IDT outputs will be: Extracted images parameters (centroids, fluxes), Match-table linking observations to sources, and Refined on-board attitude.

The system is developed by DPAC within CU3 with major contributions from University of Barcelona, Spain.

7. Conclusions

The SOC has a diverse role to play in the Gaia data processing in conjunction with and as part of the DPAC and look forward to meeting the Gaia processing challenges.

References

Hobbs, D., Lindegren, L.,Holl B., Lammers. U., O'Mullane. W. 2008, *IAU Symposium 248.*